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DEVELOPMENT OF THE METHOD OF CONSTRUCTING THE GRAPHIC MODEL OF TEXTILE PACKAGES BY EXPERIMENTAL DATA

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The object of research is methods for analyzing the geometric parameters of textile packages formatted on machines with separate processes of yarn formation and winding. One of the most problematic places for analyzing the deviation of the shape of packages from the required is a large amount of information about the coordinates of the points of the surface of the package obtained as a result of measurements. Elimination of this problem is possible due to the creation of a volumetric packing model that allows to visually assess the presence of defects on the package surface and carry out a subsequent quantitative analysis.

In the course of the research, an experimental method is proposed for obtaining primary data characterizing the shape of individual meridional sections of the package. An experimental setup has been developed that makes it possible to obtain data and store it in digitized form, and a method for converting the data obtained into a volumetric geometric model of a textile package.

It is established that the developed model allows to obtain a number of single indicators of deviation of the shape of the bobbins from the given one and further to work on the formation of a complex index for evaluating the quality of the bobbin shape. Complex evaluation of the quality of the package form can be obtained by the weighted average method. The average weighted index is constructed as a dependence, the arguments of which are single quality indicators and parameters of their weight.

The estimation of applicability of the developed complex indicator for the analysis of the form of packages is carried out. To do this, the package lot analysis is carried out, which confirmed the reproducibility of the package shape analysis process with the help of the proposed complex indicator, as well as the correspondence of the estimates obtained by the proposed method to visual estimates.

The method of complex quantitative evaluation of the form of packages, presented in this paper, allows to carry out optimization experiments and on their basis to assign such adjustable parameters of winding mechanisms that will allow to receive packages of the required quality. When developing new winding equipment, it will be possible to lay down the necessary mechanisms for regulating the winding process.

Keywords: images of the shadow projection, bobbin forms, cross-sections at the butt ends, pattern recognition.

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INCREASING THE TECHNICAL LEVEL OF A TORQUE FLOW PUMP BY CHANGING THE GEOMETRY OF A FLOWING PART

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The object of research is a pump of dynamic principle of action, namely a TFP «TURO» type (Switzerland).

The main TFP disadvantage is a lower value of the efficiency compared with centrifugal pumps. This is due to the peculiarity of their working process – the formation of a longitudinal vortex in the free chamber of the pump, the maintenance of which consumes part of the power consumed by the pump.

The analysis of a priori information indicates the expediency of using a change in the geometry of the flowing part of the pump as a means of influencing its pressure and energy characteristics. Extending the part of the blades of the impeller to the free chamber allows the combined working process (blade and vortex) to be used in the pump, which will increase the efficiency of the pump without losing the significant advantages inherent in this type of pumps.

Experimental impellers were made and a test was carried out on an experimental bench. The obtained results indicate the possibility of increasing the head and efficiency of the pump while maintaining the location of the optimal regime.

The nomenclature of quality indicators is determined, according to which the comparison of the created pump and the analog pump is carried out. The Harrington method (the «desired function» method) was chosen to determine the basic quality measure. The weight coefficients for quality indicators are determined and the integral indicator of the technical level of the created pump and analog pump is calculated.

The use of the SST model of turbulence for the numerical simulation of flow in the TFP flowing part is substantiated. Numerical calculation is performed and integral values of the pump are obtained.

The proposed design allows to create new pumping equipment with improved performance and a higher technological level, or increase the relevant indicators of existing equipment by making changes to the impeller design. These changes do not require significant costs and do not require the use of complex equipment and can be implemented directly at the site of operation by the company's own forces or the operating organization.

Keywords: torque flow pump, impeller, technical level, turbulence model.

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MATHEMATICAL MODELING OF SPEED CHANGE OF VEHICLES AT EMERGENCY BRAKING

page 22–28

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The object of research is the reconstruction of the development of the mechanism and circumstances of the road accident. The key point of research is establishment of the car speed at different moments in the development of a traffic accident. Precisely the accuracy in determining the car speed affects the nature of the main findings of the examination. When calculating the car speed, the expert solves the inverse problem, that is, determines the speed according to the braking performance of the car and the length of the trail of braking. For the last two decades, the design of the car's brake system has changed. The brakes are equipped with antilock braking systems. At the same time, the efficiency of vehicle braking has improved significantly. But it turned out that experts can't objectively determine the car speed, which is equipped with an anti-lock braking system, because such brakes do not leave traces of braking on the road surface.

When developing and solving this problem by determining the vehicle speed, the vehicle is equipped with an anti-lock braking system, methods of differentiating and integrating a complex function are used. With a comparative analysis of the existing and proposed methods for calculating the speed of the car in the process of emergency application braking, the graphical method.

According to the research results, a mathematical model for determining the speed of the car is developed, which is equipped with an anti-lock braking system. This model allows to take into account the effect of the forces of air resistance, resistance to movement and resistance to recovery not only in the steady phase of braking, but also during the reaction of the driver and the timing of the brakes. An analysis of the mathematical model shows that during these time intervals a certain deceleration will act on the car, which will depend on the speed of movement and the state of the car. Moreover, the action of the drag resistance force can significantly increase this deceleration and influence the change in the car speed. The proposed mathematical model more accurately displays the actual process of emergency braking of the car and provides a reduction in the error in calculating the speed of the car by 4–8 % compared with existing calculation methods.

Keywords: road accident, changes in vehicle speed, emergency braking process, anti-lock braking system.

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INVESTIGATION OF STRUCTURAL CAST IRON HARDNESS FOR CASTINGS OF AUTOMOBILE INDUSTRY ON THE BASIS OF CONSTRUCTION AND ANALYSIS OF REGRESSION EQUATION IN THE FACTOR SPACE «CARBON (C) - CARBON EQUIVALENT (C_{eq})»

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The object of research is structural iron with lamellar graphite, in which the carbon equivalent (C_{eq}) is in the range (4.2–4.4) %, and the carbon content (C) in the range (3.42–3.57) %. The aim of research is description of the distribution of the hardness value of structural cast iron of serial meltings in the $C–C_{eq}$ factor space at fixed values of the Cr–Ni–Cu–Ti alloy content in narrow intervals. It is shown that a polynomial regression equation of the form $HB=HB(C, C_{eq})$ can be used to obtain a workable analytical description. It is shown that such structure of the equation and those obtained by the method of least squares corresponding coefficient estimates provide 92 % accuracy of the forecast even with a small sample of data.

On the basis of the canonical transformation of the response surface and its ridge analysis, it is established that it is possible in principle to satisfy different requirements for hardness. So, if the range of the planning area $C=(3.42–3.57)$ % and $C_{eq}=(4.2–4.4)$ % is chosen as the imposed constraint, then several suboptimal solutions are possible. This is the case if the task of minimizing hardness is not set and the range $HB=180–250$ satisfies the quality requirements specified by the production conditions. If the priority is hardness minimization, then the suboptimal solution is one and it is like the point of intersection of the constraint line ($r=1.414$) and the lower ridge line $y=y(r)$. On the basis of this, it is concluded that the suboptimal solutions are multivariant, depending on the requirements of production. A nomogram has been constructed, which makes it possible to select in a rational way the technological regimes of out-of-furnace treatment in the part concerning the adjustment of the chemical composition of the alloy.

Keywords: cast iron hardness, structural cast iron, chemical composition of cast iron, regression equation, canonical transformation, combined analysis.

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MATERIALS SCIENCE

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REGULATION OF THE INFLUENCE OF THE STRUCTURE OF INORGANIC BINDERS ON THEIR PROPERTIES

page 37–42

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The object of research is the interaction of the cement paste with siliceous aggregates and fillers that contain iron ions. Under normal conditions of hardening, mainly calcium hydrosilicates, CSH(B), CS_2H and hydrogarnets are formed in the contact zone. One of the most problematic areas is the interaction of the hardening cement test from aluminosilicate and the iron silicate filler. At the same time, an increased amount of hydrosilicates of different degree of basicity, hydroaluminates, hydrogarnets with a different ratio of SiO_2, Fe_2O_3, H_2O appears in the contact zone.

In the course of the study, a contact layer was studied, resulting from the interaction of the hardening cement dough with the surface of aggregates of the mixture, represented by an adhesive. This substance provides, in varying degrees, the adhesion of the aggregate to the overall monolith. Cement contributes to the restoration and extension of conventional hydration processes. This is due to the fact that the proposed method is an active way to strengthen the microdispersed material by introducing additional substances into the inorganic binders into the contact zone or into the cement paste.

Thanks to this, it is possible to increase adhesion due to water accumulation, blockage of pores and cracks, increase in wettability and solubility of cement minerals, the emergence of new complex crystalline formations, and the like. Microfillers contribute to reducing deformation shrinkage and swelling, characteristic of hardening the highly dispersed clinker part of cement. They can also increase the resistance of the cement stone to the action of aggressive factors, reducing the consumption of cement and the cost of concrete.

Thus, by various methods, the structure of the resulting substances based on inorganic binders can be regulated, influencing their properties in the desired directions.

Keywords: cement paste, formation of hydrosilicates, interaction of cement stone with ferruginous silicates.

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TECHNOLOGY AND SYSTEM OF POWER SUPPLY

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EFFECTIVENESS STUDY ON THE SYSTEM FOR GAS GATHERING, TREATMENT AND TRANSPORTATIONS FROM GAS PRODUCTION COMPANY

page 43–52

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Results of the analysis of gathering and processing and transmission systems efficiency are presented in work for Opishnia, Kotelva and Zakhidna-Berezivska gas-condensate fields of the UkrGasVydobuvannya, Joint-Stock Company (Kyiv, Ukraine). The main complications of gas-gathering system at the final stage of fields' development are revealed and some meanings for estimation of their negative impact on volume of production are proposed.

At the first stage of the research, field measurements were made of the operating modes of the system in summer and winter. It has been experimentally established that during the winter period of operation the process of gas separation on separation equipment is performed more qualitatively than in summer operation. This is due to the effect of low temperatures on the process of precipitation of the liquid phase from natural gas.

The main idea of work lays in introduction of continuous monitoring of gas-gathering system operating with identification of changes of the thermobaric modes. Such changes can signal high probability of liquid accumulations that creates additional hydraulic resistance.

Results of monitoring of P–T profile, changes in dew points and natural gas composition allow to carry out complex analysis with acceptable accuracy to estimate a possibility of liquid accumulation in certain points of the piping system. This excludes need of confirmation of their existence by means of the instrument metering and additional human resources and reduces time needed for problem identification.

Such approach will be rather interesting also to the large international companies as reserves of natural gas are constantly decline, and recovery of residual reserves from the depleted fields in gas drive mechanism is the attractive purpose for the gas productions companies. Furthermore, application of easy ways of cleaning based on the analysis of hydraulic efficiency of pipelines allows to reduce significantly both timing, and material resources.

Keywords: system of gas collecting, multiphase stream, industrial gas pipeline, pipe section, hydraulic efficiency.

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RESEARCH INTO ENERGY EFFICIENCY OF THE UNDERFLOOR HEATING SYSTEM, ASSEMBLED DRY

page 52–57

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The object of research is the thermal parameters of operation of a fragment of the floor heating system assembled dry, under conditions of actual application set in the lab premises.

One of the most problematic issues in the course of our experimental study has turned out to be a small area of the investigated heating system, relative to the volume of the room. Considerable ambient air temperature fluctuations resulted in certain difficulties while the heating system entered the quasi-steady mode.

We have established in our study the effect of thickness of a heat insulation layer under the heating circuit on a change in the density of heat flow from the floor surface to the air in a heated room. It is noted that the floor heating system, assembled dry, has small thermal inertia due to the absence of a relatively thick layer of the monolithic concrete slab (with high specific heat capacity), which is typically used for the installation of a heating system circuit.

Specifically, it was established that the use of ceramic tiles as the finish coating, compared with laminate, significantly reduces the overall thermal resistance of heat transfer from a heat carrier to the air in a heated room. In this case, the presence of an aluminum heat-scattering plate, which is in direct contact with the outer surface of the pipe in a heating circuit, has a positive effect on the uniformity of distribution of thermal field in the plane of the floor. This in turn leads to a reduction in thermal stresses in the finish coating.

Calculations show that the quantitative control over thermal load of such a system by changing the consumption of a heat carrier proves to be less effective than the qualitative control through changing its temperature.

Experimental studies reveal that the density of a heat flow on the floor surface increases almost two-fold when using ceramic tiles, in comparison with laminate, at all other thermal system settings being almost identical.

The research we conducted make it possible to construct a mathematical model for the operation of a floor heating system, assembled dry, whose application would enable the optimization calculations and improvement of the design of a given heater.

Keywords: water floor heating, heating circuit, thermal load, thermal resistance of heat transfer, thermal mode in facilities.

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IDENTIFICATION OF OBJECTS PRIORITY FOR CONDUCTING ENERGY MONITORING

page 58–63

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The object of research is the energy monitoring system. To achieve a high level of energy efficiency in any enterprise, it is necessary to periodically evaluate the level of effectiveness of energy saving activities, that is, to carry out energy monitoring. One of the most problematic places in creating energy monitoring systems is the prioritization of facilities for which it is possible and appropriate to monitor. When determining the objects for which it is expedient to create an energy monitoring system, it is necessary to take into account the basic requirements that such facilities should meet. Among such requirements: the location of objects in one or adjacent premises, a single technological process and the management of these objects of a small number of operators. In accordance with these requirements, an algorithm for selecting objects for creating an energy monitoring system is proposed. At the first stage all equipment of the enterprise should be divided into a small number of groups on a technological basis. The next step is building energy consumption balances separately for each of the technological processes of production of all types of enterprise products. To compile energy consumption balances, a methodology for constructing optimal energy balance models can be applied. Based on the calculated values of energy consumption for the production of each type of product, equipment can be distributed into smaller groups based on two criteria. These criteria include the location of equipment and their power supply from the same power points. The resulting equipment groups are the previous objects, but this does not mean that an energy monitoring system is appropriate for such facilities. In this paper, solution of additional problems is proposed, in particular:

– determination of the composition of factors that affect the amount of energy consumption;

– expediency of installing additional meters for energy consumption, production and other parameters;

– estimation of monetary expenses for creation of systems;

– estimation of energy saving potential;

– financial analysis of the feasibility of creating systems.

Thanks to this, it is possible to reasonably determine the objects for which it is technically possible and financially feasible to create an energy monitoring system.

Keywords: implementation of the energy monitoring system, energy efficiency level of the enterprise, use of energy resources.

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